

## In the Claims

- 1    1. (currently amended) A method for detecting symbols of a modulated
- 2    signal received via channels of a wireless communications system,
- 3    comprising:
  - 4       obtaining an initial estimate of a symbol transmitted via the channels
  - 5       from a previous channel estimate and a received symbol;
  - 6       updating the channel estimate;
  - 7       optimizing ~~the a~~ next estimate of the transmitted symbol which
  - 8       maximizes an expectation of a log likelihood function by averaging a
  - 9       logarithm of a likelihood function over unknown parameters  $h$  of the
  - 10      channels;
  - 11      quantizing the next estimate of the transmitted symbol;
  - 12      comparing the quantized next estimate of the transmitted symbol with
  - 13      the previous initial estimate of the transmitted symbol to determine if the
  - 14      previous initial estimate of the transmitted symbol and the quantized next
  - 15      estimate of the transmitted symbol have converged; and otherwise
  - 16      inputting the quantized next estimate of the transmitted symbol as the
  - 17      initial estimate of the transmitted symbol; and
  - 18      repeating the updating, the optimizing, the quantizing, and the
  - 19      comparing until the previous initial estimate of the transmitted symbol and
  - 20      the quantized next estimate of the transmitted symbol converge.

1    2. (currently amended) The method of claim 1 wherein the modulated signal  
2    is a MPSK modulated signal having a positive constant equivalent to an  
3    energy of the modulated signal, and using only phase information during the  
4    updating.

1    3. (currently amended) The method of claim 1 wherein the comparing  
2    further comprises:

3         subtracting the previous initial estimate of the transmitted symbol  
4    from the quantized next estimate of the transmitted symbol to obtain a  
5    difference; and

6         determining that the previous initial estimate and the quantized next  
7    estimate have converged when an absolute value of the difference is less  
8    than a predetermined threshold.

1    4. (currently amended) The method of claim 1 further comprising:

2         obtaining the initial estimate of the transmitted symbol from the  
3    channel estimate of a pilot symbol received via the channels.

1    5. (currently amended) The method of claim 1 further comprising:

2         obtaining the initial estimate of the transmitted symbol from the  
3    channel estimate of a previously received symbol.

1    6. (currently amended) The method of claim 1 wherein the optimizing  
2    further comprises:

3         using only a fast Fourier transform matrix, the received signal symbol,  
4    and the previous channel estimate .

1    7. (currently amended) The method of claim 1 wherein the next estimate of  
2    the transmitted symbol is quantized according to ~~the signal constellation a~~  
3    constellation of the received signal.

1    8. (currently amended) The method of claim 1 further comprising:  
2         determining a posterior covariance matrix  $\Sigma_p$   $\hat{\Sigma}_p$  of the channels using  
3         a FFT matrix  $\mathbf{W}$ , the previous initial estimate of the transmitted symbol  $\mathbf{X}_p$ ,  
4         the received symbol  $\mathbf{Y}$ , and a Gaussian noise variance  $\sigma^2$  as  
5         
$$\hat{\Sigma}_p = (\mathbf{W}^H \mathbf{X}_p^H \mathbf{X}_p \mathbf{W} / \sigma^2)^{-1},$$
  
6         determining a posterior mean  $\hat{h}_p$  of a channel impulse response as  
7         
$$\hat{h}_p = \hat{\Sigma}_p (\mathbf{W}^H \mathbf{X}_p^H \mathbf{Y} / \sigma^2);$$
  
8         determining a channel update coefficients matrix  $\mathbf{C}$  for recovering the  
9         next estimate of the transmitted symbol; and  
10         applying the coefficient matrix  $\mathbf{C}$  to the posterior mean  $\hat{h}_p$ , the FFT  
11         matrix  $\mathbf{W}$ , and the received signal symbol  $\mathbf{Y}$  according to  
12         
$$\tilde{\mathbf{X}}_{p+1} = \mathbf{C}^{-1} (\hat{h}_p^H \mathbf{W}^H \mathbf{Y})^T$$
 to optimize the next estimate of the transmitted symbol  
13          $\mathbf{X}_{p+1}$   $\underline{\tilde{\mathbf{X}}_{p+1}}$ .

1    9. (currently amended) The method of claim 1 further comprising:  
2         determining a posterior covariance matrix  $\Sigma_p$   $\hat{\Sigma}_p$  of the channels using  
3         a FFT matrix  $\mathbf{W}$ , the previous estimate of the transmitted symbol  $\mathbf{X}_p$ , a  
4         channel convergence matrix  $\Sigma^{-1}$ , and a Gaussian noise variance  $\sigma^2$  as  
5         
$$\hat{\Sigma}_p = (\mathbf{W}^H \mathbf{X}_p^H \mathbf{X}_p \mathbf{W} / \sigma^2 + \Sigma^{-1})^{-1};$$

6 determining a posterior mean  $\hat{h}_p$  of a channel impulse response as  
7  $\hat{h}_p = \hat{\Sigma}_p (\mathbf{W}^H \mathbf{X}_p^H \mathbf{Y} / \sigma^2 + \Sigma^{-1} E\{\underline{h}\})$ , where the received symbol is  $\mathbf{Y}$ , and  $E\{\underline{h}\}$  is  
8 a channel impulse response;  
9 determining a channel update coefficients matrix  $\mathbf{C}$  for recovering the  
10 next estimate of the transmitted symbol; and  
11 applying the coefficient matrix  $\mathbf{C}$  to the posterior mean  $\hat{h}_p$ , the FFT  
12 matrix  $\mathbf{W}$ , and the received signal symbol  $\mathbf{Y}$  according to  
13  $\tilde{\mathbf{X}}_{p+1} = \mathbf{C}^{-1} (\hat{h}_p^H \mathbf{W}^H \mathbf{Y})^T$  to optimize the next estimate of the transmitted symbol  
14  $\underline{\mathbf{X}_{p+1}} - \underline{\tilde{\mathbf{X}}_{p+1}}$ .

1 10. (cancelled)

1 11. (original) The method of claim 1 further comprising:  
2 modulating the signal using orthogonal frequency division  
3 multiplexing.

1 12. (currently amended) A system for detecting symbols of a modulated  
2 signal received via a plurality of channel of a wireless communications  
3 system, comprising:  
4 means for obtaining an initial estimate of a symbol transmitted via the  
5 channels;  
6 means for updating the channel estimate;  
7 means for optimizing a next estimate of the transmitted symbol which  
8 maximizes an expectation of a log likelihood function by averaging a  
9 logarithm of a likelihood function over unknown parameters  $h$  of the

10    channels;

11        means for quantizing the next estimate of the transmitted symbol;  
12        means for comparing the quantized next estimate of the transmitted  
13      symbol with the previous estimate of the transmitted symbol to determine if  
14      the previous initial estimate and the quantized next estimate have converged;  
15      and otherwise

16        means for making the quantized next estimate of the transmitted  
17      symbol an input for a next iteration; and

18        means for repeating the updating, the optimizing, the quantizing, and  
19      comparing until the previous initial estimate of the transmitted symbol and  
20      the quantized next estimate of the transmitted symbol converge.

1    13. (currently amended) The system of claim 12 wherein the modulated  
2      signal is a **MPSK** multiple phase shift keying modulated signal having a  
3      positive constant equivalent to an energy of the modulated signal, and using  
4      only phase information during the updating.

1    14. (currently amended) The system of claim 12 further comprising:  
2        means for subtracting the previous initial estimate of the transmitted  
3      symbol from the quantized next estimate of the transmitted symbol to obtain  
4      a difference; and  
5        means for determining that the previous initial estimate and the next  
6      estimate have converged when an absolute value of the difference is less  
7      than a predetermined threshold.

1 15. (currently amended) The system of claim 12 wherein the initial estimate  
2 of the transmitted symbol is obtained from a pilot symbol received via the  
3 channels.

1 16. (currently amended) The system of claim 12 wherein the initial estimate  
2 of the transmitted symbol is obtained from a channel estimate from the  
3 previous a previously received symbol.

1 17. (currently amended) The system of claim 12 further comprising:  
2 means for determining a posterior covariance matrix  $\Sigma_p \hat{\Sigma}_p$  of the  
3 channels using a FFT matrix  $\mathbf{W}$ , the initial estimate of the previous  
4 transmitted symbol  $\mathbf{X}_p$ , the received symbol  $\mathbf{Y}$ , and a Gaussian noise  
5 variance  $\sigma^2$  as  $\hat{\Sigma}_p = (\mathbf{W}^H \mathbf{X}_p^H \mathbf{X}_p \mathbf{W} / \sigma^2)^{-1}$ ,  
6 means for determining a posterior mean  $\hat{h}_p$  of the channel impulse  
7 response as  $\hat{h}_p = \hat{\Sigma}_p (\mathbf{W}^H \mathbf{X}_p^H \mathbf{Y} / \sigma^2)$ ;  
8 means for determining a channel update coefficients matrix  $\mathbf{C}$  for  
9 recovering the next estimate of the next transmitted symbol; and  
10 means for applying the coefficient matrix  $\mathbf{C}$  to the posterior mean  $\hat{h}_p$ ,  
11 the FFT matrix  $\mathbf{W}$ , and the received signal symbol  $\mathbf{Y}$  according to  
12  $\tilde{\mathbf{X}}_{p+1} = \mathbf{C}^{-1} (\hat{h}_p^H \mathbf{W}^H \mathbf{Y})^T$  to maximize the next estimate of the next symbol  $\mathbf{X}_{p+1}$   
13  $\underline{\tilde{\mathbf{X}}_{p+1}}$ .

- 1 18. (currently amended) The system of claim 12 further comprising:
- 2 means for determining a posterior covariance matrix  $\Sigma_p$   $\hat{\Sigma}_p$  of the
- 3 channels using the FFT matrix  $\mathbf{W}$ , the initial estimate of the previous
- 4 transmitted symbol  $\mathbf{X}_p$ , a channels channel convergence matrix  $\Sigma^{-1}$ , and a
- 5 Gaussian noise variance  $\sigma^2$  as  $\hat{\Sigma}_p = (\mathbf{W}^H \mathbf{X}_p^H \mathbf{X}_p \mathbf{W} / \sigma^2 + \Sigma^{-1})^{-1}$ ;
- 6 means for determining a posterior mean  $\hat{h}_p$  of the channels a channel
- 7 impulse response as  $\hat{h}_p = \hat{\Sigma}_p (\mathbf{W}^H \mathbf{X}_p^H \mathbf{Y} / \sigma^2 + \Sigma^{-1} E\{\underline{h}\})$ , where the received
- 8 symbol is  $\mathbf{Y}$  and  $E\{\underline{h}\}$  is a channel impulse response;
- 9 means for determining a channel update coefficients matrix  $\mathbf{C}$  for
- 10 recovering the estimate of the next transmitted symbol; and
- 11 means for applying the coefficient matrix  $\mathbf{C}$  to the posterior mean  $\hat{h}_p$ ,
- 12 the FFT matrix  $\mathbf{W}$ , and the received signal symbol  $\mathbf{Y}$  according to
- 13  $\tilde{\mathbf{X}}_{p+1} = \mathbf{C}^{-1} (\hat{h}_p^H \mathbf{W}^H \mathbf{Y})^T$  to maximize the next estimate of the next symbol  $\mathbf{X}_{p+1}$
- 14  $\underline{\tilde{\mathbf{X}}_{p+1}}$ .

1 19. (cancelled)

1 20. (original) The system of claim 12 wherein the signal is modulated using

2 orthogonal frequency division multiplexing.